description or the Final Environmental Impact Statement, Chapter II for an overview of this management strategy) This strategy is consistent with implementation of the Pacific States Bald Eagle Recovery Plan There are no known nesting occurrences of American peregrine falcons on the Forest, however, potential American peregrine falcon aeries have been identified within the Strawberry Mountain Wilderness None of the alternatives would impact these sites A survey will be made for the American peregrine falcon in the Strawberry Mountain Wilderness Area, and if no birds are found, the species will be introduced, as per Recovery Plan objectives None of the alternatives should cause loss of habitat for Threatened, Endangered or Sensitive species The USDI Fish and Wildlife Service has reviewed the biological evaluations and concurs with the determination of no effect on the bald eagle and the American peregrine falcon (USDI, FWS, 1988)

5 Human Resource Programs

The human resource programs of the Malheur National Forest are funded independently of the Forest Plan They are unrelated to Forest Plan management alternatives and would not be likely to vary by alternative

E Effects That Vary by Alternative

1 Effects on Soils

Most forest management activities impact the soil resource to some extent The degree to which the soil is impacted is generally related to the total amount of the activity planned An example is timber harvesting The greatest potential for adverse impact exists with alternatives that have the highest harvest rates

It is important to note that not all soil disturbance is undesirable Many of the tree species that occur on the Forest require bare mineral soil to germinate Disturbance (site prep) is typically required to expose mineral soil The disturbance that is critical to forest managers is one reduces the long-term productivity of the site Detrimental soil conditions that are known to reduce site productivity and for which the Forest Service has developed standards are compaction, displacement, puddling, severe burning, and erosion in terms of effective ground cover (see Glossary for definitions) Other site factors that can impact productivity but for which no specific standards have been developed are soil nutrient levels, organic debris (limbs, down logs, etc) and fire intensities.

Intensive soil monitoring has been used effectively on the Malheur National Forest to ensure that soil protection standards have been met Results from samples of 24 tractor harvest units revealed excessive compaction where units had been logged more than once Changes in management have been made to ensure compliance with soil protection standards.

More specific comments on effects will be made by resource area As previously noted, the units with the greatest amount of outputs and activity will be the units with the greatest impact to the soil Overall, Alternatives NC, B-Modified, and F will have the greatest adverse impact due to the high level of output in those areas Alternatives A, and I will have moderate resource impacts, and Alternative C-Modified will have the least amount of impact

a *Timber Management Effects on Soils*

Timber management activities affect a large portion of the Forest Although the specific amounts vary by alternative, an average of about 900 thousand acres (plus or minus 10 percent) is available for timber harvesting on the Malheur National Forest (amount of acres available for scheduled timber harvest within the FORPLAN model for all viable alternatives) Of that, approximately 80 percent have slopes less than 35 percent that are subject to tractor logging While cable logging can result in detrimental impacts, most cable units stay well within the standards as routine mitigation measures are applied

The activities most likely to result in detrimental soil impacts are tractor logging, machine piling, and road construction The relative amounts of the activities by alternative are presented in Table IV-1

TABLE IV-1: Major Soil-Disturbing Activities by Alternatives
(First Decade Average Annual Outputs or Effects)

Alternatives	Annual Harvest (MMBF)1/	Thousands of Acres Impacted	Thousands of Acres Tractor Yarded	Thousands of Acres Machine Piled	Miles/Year of New Road Construction
NC (No Change)	N/A	N/A	N/A	N/A	N/A
A (No Action)	233	33	32	1.7	81
B-Modified	266	36	35	1.8	81
C-Modified	154	21	20	1.0	49
F	247	35	34	1.7	80
I (Preferred)	211	28	27	1.4	62

1/MMBF = Million board feet of total sale program quantity (TSPQ)

Soil monitoring has shown compaction to be the most detrimental to the soil condition on tractor units (Slaughter and Gasbarro, 1988) Most of the excessive compaction occurs during machine piling On the steep units (greater than 35 percent) displacement is the major concern. Displacement is more critical because it is an irreversible loss of soil Compaction can be alleviated through ripping

Erosion is another hazard that must be specifically addressed, because of the potentially irreversible consequences When the standard protection measures are not sufficient, there are optional measures available

The erosion hazard is typically confined to compacted skid trails and landings where the infiltration rates have been reduced Problems in the forested area outside these compacted areas are very limited

Timber felling does not directly affect the soil resource; however, it does affect the way that machines can transport, or skid, logs to the sorting and loading area (landing). If trees are felled in a way which reduces the area that the machines travel on (skid trails) then the impact to the soil in the total timber sale area can be minimized

The major adverse impact from timber harvesting on soil results from tractor skidding. Tractor logging typically results in well-defined skid trails on the ground. Garland (1983) reported that as much as 40 percent of an area could be covered with skid trails if allowed to occur unchecked Skid trails are nearly always compacted (Foil and Ralston 1967; Froehlich 1979) Soil compaction decreases soil productivity (Froehlich 1979; Froehlich and McNabb 1983, Wert and Thomas 1981). Overall growth reductions from 5 to 15 percent have been reported in the Pacific Northwest (Adams and Froehlich 1981; Froehlich et al., 1981)

Site preparation methods differ greatly in their impact to the soil The primary methods used on the Malheur National Forest include machine piling, mechanical treatment, burning, and crushing. In recent years, the practice of not treating slash has been used frequently. Research has shown that it is beneficial to the long-term productivity of the forest to leave the slash on the site If there is no reason to treat the slash it will be left on the site.

Machine piling is the most severe treatment Forest monitoring results (Slaughter and Gasbarro 1988) have shown machine piling to result in excessive compaction on units that have been logged more than once. This is particularly true when machine piling is being used to achieve a site preparation objective

Mechanical treatment and burning can generally be done without significant impact to the soil The effect of crushing depends on the amount of slash

Compaction is by far the most widespread environmental consequence, related to soils, that occurs as a result of timber management Displacement, puddling, and erosion also occur in minor amounts Displacement generally occurs on designated skid trails with slopes greater than 35 percent The potential for displacement is greatest on ash soils when large volumes of logs are skidded Puddling generally occurs on soils that have a clay content of more than 35 percent and a high moisture content (35-52 percent moisture by weight depending on the texture) Erosion is primarily a concern on compacted skid trails, temporary roads, landings, and roads

The cumulative effect of repeated entries can have an adverse significant effect on the soil resource. Forest monitoring results (Slaughter and Gasbarro 1988) have shown that the cumulative effect of multiple entries commonly results in excessive amounts of soil compaction on tractor units Units that have been logged previously typically receive special protective measures designed to prevent additional compaction Those measures include designated skid trails, directional falling, winching, and an alternative to machine piling Ripping is used to alleviate excessive compaction where possible

b *Effects of Range Management on Soils*

The effect of grazing on the soil resource needs to be discussed in terms of both the historic grazing practices and our current grazing policies Early sheep and cattle grazing practices have accelerated erosion over a good portion of the range and more open timber types. Photographs of meadows taken in the 1930's showed meadows completely denuded and gullied

Range Management Practices in the past 20 to 30 years have made great strides in reducing the impacts to the systems Also, better control of the livestock has served to improve the range on the Forest The problem areas that still exist today have been inventoried in the Watershed Improvement Needs Inventory and are scheduled for improvement The Malheur National Forest has developed an aggressive program of watershed improvements

The potential for impacting the soil resource is related to the total number of Animal Unit Months (AUMs) permitted on the Forest Those numbers are presented under Chapter II, in Figure II-36, as grazing capacity by alternative

c *Effects of Wildlife on Soils*

The effects of deer and elk grazing on the soil resource are similar to the impacts of cattle Concentrated trampling and intensive use can result in accelerated erosion and compaction Only scattered trampling and erosion problems presently occur There is a risk, however, that the increasing elk herds anticipated, regardless of alternative, could result in accelerated erosion on fragile, nonforested portions of the winter ranges These are sites that were severely eroded during the early years of sheep and cattle grazing

d *Effects of Recreation on Soils*

The desirability of a site for recreation use may be affected by soil factors like drainage, erosiveness, and compactability. These factors are used in determining a site's suitability for campsites, playfields, pit toilets, etc It is important that soil limitations be considered in selecting sites for development Soil limitation may be a reason for nonselection of a site or for developing mitigation criteria in the facility design

Public use at developed sites often denudes and compacts the soil surface (Beardsley and Wagar 1971; Cull et al , 1981) Past monitoring results show that all developed sites tested were compacted Compaction seals the soil surface and greatly reduces the water infiltration rate When rain falls or snow melts much of the water runs off, which can cause accelerated soil erosion The combined effect of erosion and compaction contributes to denuding of tree roots, and also reduces availability of air, water, and nutrients to vegetation.

Dispersed sites generally are not compacted, however, continued use over time will cause soil compaction.

Sites located at higher elevations are generally more sensitive to heavy use than are similar sites located at lower elevations This is probably due to colder temperatures and shorter growing season and the fact that native vegetation is often more sensitive to trampling and soil compaction

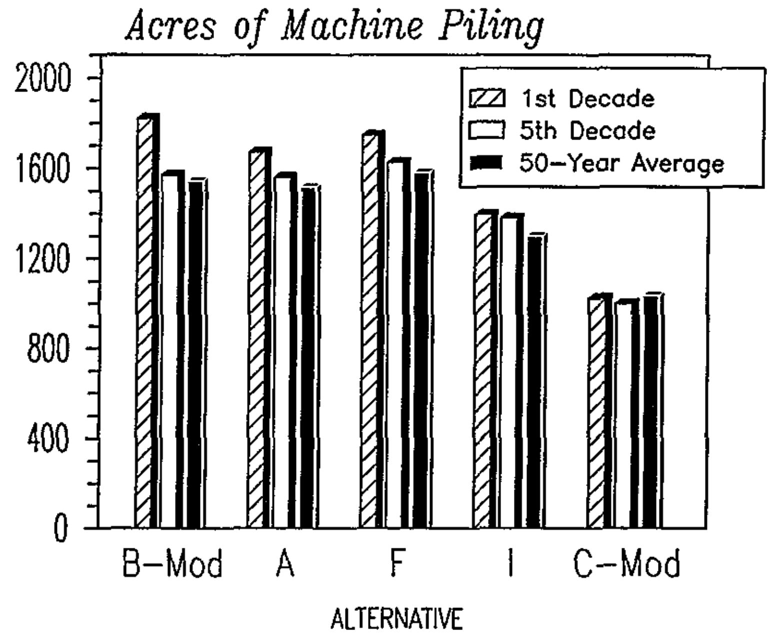
All forms of trail use have some localized impact on the soil resource. Essentially all trail treads are compacted so water infiltration is very slow. This means trails could become channels for surface runoff water. Trails are constructed to prevent unacceptable soil erosion and gullying The impact on trails by hikers' boots, horses' hooves, or trail bike tires varies with soil texture All have the potential for water puddling, displacement of soils, and a tendency to entrench the trail tread into a "U" shape. Sediment from trail tread erosion is often deposited directly into small streams, which can affect water quality.

e Fire Management Effects on Soils

Fire management activities affect the soil resource in three ways. The first is the effect that machines used for piling slash have on the physical condition of the soil; the second is the effect that removing woody debris has on long-term productivity of the site; and the third is the effect of fire itself on the soil

Machine piling is the leading cause of soil compaction based on Forest monitoring results. This is especially true when the machine piling activity is used as preparation of an area for planting The only difference between alternatives in terms of machine piling is the total number of acres planned. Figure IV-1 shows the total number of acres scheduled for each alternative The higher the number, the more areas which will be affected.

FIGURE IV-1: Machine Piling by Alternative



Woody debris is an important contributor to the long-term productivity of the Forest Large woody debris is also an important component of fish and wildlife habitats The smaller material is an important source of nutrients in the short term (20-30 years), while the larger material (12-inch plus) has been shown to be extremely important to growth and survival of soil mycorrhizae, a root fungus that many trees depend on for survival (Bergstrom 1976, Thomas 1979) Removing the woody material reduces the site productivity. Loss of woody debris will occur in every alternative, there is no measurable difference between alternatives

Prescribed fire can produce the following effects reduction of plant competition on selected species, enhancement of plant community stability, exposure of mineral soil for natural seeding; increased availability of nutrients; reduced fuel loads, and reduction of certain microorganisms Uncontrolled fire can result in total consumption of the organic layer of the soil, which depletes the nutrient supply and increases the potential for surface erosion. It can also result in a condition called water repellency which increases the erosion hazard substantially. Additional information can be found in a publication by Boyer and Dell (1980) Prescribed fire will be used in implementation of any of the alternatives, but the extent of use would be determined on a site-specific basis It is impossible to predict the occurrence of wildfires

f. *Mining Impacts on Soils*

Mining exploration and development can have a significant impact on the soil resource depending on the activity Surface mining has the greatest impact. This type of mining generally involves removing the productive surface soil in order to get to ore-bearing subsoils and bedrock Underground mining impacts much less surface area

g *Effects of Transportation Management on Soils*

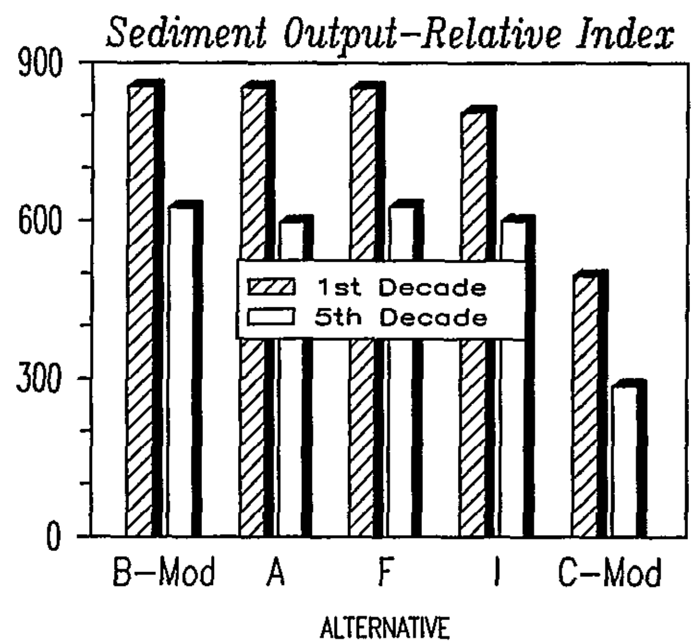
The transportation system has two basic effects on the soil resource First, it takes land out of production Once a road has been constructed, the site has lost its potential to grow trees The cut-and-fill slopes, and even the road itself, may support vegetation of some kind, but the small amount of production that does occur is not part of the suitable land base for growing trees

The second effect is the impact of the road on water quality over time. Roads are major collectors and funnels of water Paved roads and rock-surfaced roads tend to produce less sediment than unsurfaced roads Surfaced roads produce little sediment over time and are easily maintained. Unsurfaced roads and native material roads are responsible for most management-related sediment that leaves the Forest, and these roads are difficult to keep maintained. Most road construction on the Forest in the future will consist of unsurfaced and native-surfaced local roads

Alternative B-Modified, with the largest amount of road construction and reconstruction, will have the greatest impact on the soil resource Alternative C-Modified will have the least.

An index of sediment yield is presented in Table II-5 in Chapter II of the Environmental Impact Statement and also in Figure IV-2 below. Sediment yield, as modeled here, is a function of the total amount of soil-disturbing activities that occur in each alternative These are gross estimates that do not distinguish between natural and management-related sedimentation. They are based on the modified universal soil loss equation. Sediment yield tables were developed for different combinations of ecoclass, roading level, harvest prescription, slope, logging system (cable or tractor), and road status (old or new). Roads in general, and new construction specifically, are the major contributors of management-related sediment. The results are presented as an index to be compared one to another and not as an absolute value. The higher the number, the more sediment that is generated The reliability of this information is somewhat low, it is based largely *on professional judgment with a minimum of data or validation It should be used only* to compare alternatives on a relative scale

FIGURE IV-2: Index of Sediment



The differences between alternatives are very small and reflect an assumption that most future new road construction will occur in the first decade The decrease in the second and fifth decades reflects the reduction in new road construction

h *Mitigation Measures*

Mitigating measures are the treatments and restrictions used to lessen the adverse impact of management activities on the soil resource Some measures are automatic such as erosion control in Division B of the timber sale contract Others are optional, used as needed for a particular activity Mitigating measures used to minimize or reduce impacts from logging include the use of dedicated skid trails, directional falling, winching, winter logging requirements, cable logging, equipment limitations, soil moisture limitations, grass seeding, ripping, etc

Designated skid trails can be very effective in controlling the amount of soil compaction on a timber sale unit The effectiveness depends on the degree to which skidding equipment is permitted to operate off designated skid trails Studies have shown that, where skidding equipment is restricted to designated skid trails, 100 percent effectiveness in controlling compaction on the rest of the sale unit is achieved (Froehlich and McNabb 1983; Froehlich et al , 1981)
In units previously tractor logged (a typical situation on the Forest), it is common to use existing, already compacted and displaced skid trails as designated skid trails in order to limit further impact to the sale unit

Waterbars and grass seeding are very effective in controlling erosion from skid trails and landings Waterbars are standard for all timber sales (Division B Requirements). Erosion seeding is used on disturbed soil along Class I, II, III, and IV streams, and on skid trails with slopes greater than 20 percent This is done in conjunction with the waterbarring In addition to the erosion seeding, other disturbed soil generally receives forage seeding through the Range Management Program This seeding also offers some erosion protection

Skyline logging is a cable system which suspends one end of the logs off the ground as they are transported to the landing This type of logging system has been used since the mid-1970's to mitigate adverse effects of tractor logging on steep slopes (Kile 1986) The Forest-wide Standards for the Forest Plan (Chapter IV, Section E) state that cable logging will generally be used on areas of 35 percent slope or steeper Based on judgment and experience, the Forest Soil Scientist and the Logging Systems Specialist have previously estimated that skyline logging is 95 percent effective as a soil protection measure

Equipment limitations are used as needed during logging and slash disposal Crawler-mounted skidders are periodically required on 35-45 percent slopes where skyline logging is not feasible The crawler-mounted skidder requirement has proven to be an effective measure on the Forest (Kile 1986)

Soil moisture restrictions are not widely used although they do hold some potential for limiting compaction The critical soil moisture values need to be validated for the Forest through monitoring Once validated, soil moisture restrictions may be an effective tool.

Winter logging is a restriction used to reduce the impact of tractor logging A winter logging designation requires either 4 inches of frozen soil or a minimum of 24 inches of snow before permitting tractors to operate This mitigation measure is generally very effective based on previous experience on this Forest

Scarification ripping is the treatment prescribed when there is an excessive amount of soil compaction over a unit Effectiveness is highly dependent on type of equipment used for the treatment (Andrus and Froehlich 1983) and soil moisture conditions The Rome plow was used extensively for several years to mitigate compaction on Forest units An informal investigation revealed this method to be ineffective, the major limitation being inadequate soil penetration The average effective depth of scarification using a Rome plow is estimated to be 4-5 inches, the average depth of compaction is 1 foot However, there are several other tools that have been shown to be effective, among them the winged ripper and the forest cultivator. Recovery of compacted soil with the winged ripper has been about 80 percent (Andrus and Froehlich 1983), making this one of the most effective soil compaction mitigation measures The winged ripper is being introduced on the Forest at this time.

Mining operations are required to stockpile topsoil prior to processing of underlying mineral bearing rock or gravel This topsoil must be replaced, contoured and revegetated upon completion of mining. Soil protection and erosion control methods employed in other operations on the Forest are also used for mining These include the use of waterbars and scarification. These mitigation measures are prescribed in the preceding paragraphs.

2 Effects on Vegetation/Trees

a *Timber Management*

Timber management activities in the alternatives are the primary influence on tree vegetation of the Forest These activities can be categorized into three levels of intensity. high, medium, and low. The main variations between alternatives are the number of acres treated in these three categories

In high-intensity timber management, most existing overstories are harvested Most understories will be managed until growth rates diminish and they become of merchantable size. This is expected to be within the next 30 to 80 years, when they will be harvested using shelterwood or clearcut harvest methods, and a new stand of trees started using planting or natural seeding The general effects of this type of timber management are discussed in Chapter III

This type of management results in a change in species composition on about 60 percent of the forested acres where timber harvest occurs These stands will contain a higher percentage of Douglas-fir, white fir, and other shade-tolerant species than they currently do Alternatives NC, A, B-Modified, and F will result in an overall shift in tree species across the Forest from shade-intolerant species, such as ponderosa pine, to potentially faster growing, shade-tolerant species, such as white fir and Douglas-fir Species composition will change once again when these stands are regenerated. Over a rotation period, regenerated ponderosa pine stands are anticipated to produce about 90 percent ponderosa pine volume and mixed conifer stands about 35 percent ponderosa pine volume Harvest compositions, by species will differ by alternatives In all cases there will be a decrease in the average size of trees being harvested, from over 20 inch trees for the next 15 to 20 years to 12 to 15-inch trees at some point in the future The percentage of trees over 20 inches DBH being harvested will be highly variable ranging from about 5 to 50 percent over the first 50 years

Alternative C-Modified will result in an increase in and continuation of ponderosa pine across the Forest except in riparian areas, elk winter ranges, undeveloped areas, and cold, moist, fir sites In addition, most forested acres across the Forest will be at or approaching the older seral stages (over 100 years old) Ponderosa pine volumes will most likely increase over the decades in this alternative with projected percentages ranging from 60 to 80 percent in decades 10 to 15. Overall harvest diameters will vary from 12 to 22 inches in DBH in the first 50 years, and increase to 16 to 24 inches in DBH in decades 10 to 15. The percentage of trees over 20 inches being harvested will be highly variable ranging from 15 to 70 percent over the same 150-year time period

Alternative I is a combination of many different high intensity management prescriptions and objectives. These range from the intensive management of existing understories to the use of uneven-aged management to produce more ponderosa pine. There will be an overall shift to the younger trees, thus younger seral stages over time. Due to use of uneven-aged management, portions of some older stands (over 100 years old) will be retained Ponderosa pine volumes will steadily decrease over the next several decades with harvestable percentages dropping from approximately 50 percent to 25-35 percent over the next 3 decades for all alternatives The last 5 decades in the planning horizon are projected to produce approximately 60 to 70 percent ponderosa pine Actual harvest diameters will vary from 20 to 22 inches DBH in the first 10 years to about 16 inches DBH after 100 years Unlike other alternatives, Alternative I produces harvestable trees that average no less than 15 inches in DBH for any decade Trees over 20 inches in DBH available for harvest will vary from 20 to 50 percent over the planning horizon, depending upon alternative strategy.

The age-class distribution will also change in managed stands The existing stands in seral stages 5 and 6 will be converted to younger seral stages (1-4) This change will be particularly evident by the end of the third decade when most of the managed stands will be in seral stages 1-4. This general trend increases diversity of the Forest in managed stands during the first three decades. (See discussion of current situation, in Chapter III) Diversity decreases after the third decade because about 60 percent of the managed acres will be at seral stage 4.

The medium intensity of timber management generally consists of a modified, but fairly intensive, form of uneven-aged management On these acres, tree vegetation will eventually be evenly distributed among the first five seral stages

In Alternatives A, B-Modified, F, and I, riparian areas across the Forest which are available for timber management activities and which are not in visually sensitive areas receive moderate-intensity timber management On these acres, there will be a shift to more shade-tolerant tree species There is also expected to be a continuous stand of trees on forested riparian acres except in lodgepole pine sites Lodgepole pine sites will generally receive small group cuts, which will meet an uneven-aged management definition. The actual rotation will be extended to a time period of about 100 years. Alternative NC will have moderate-intensity timber management consisting of an extended rotation of 190 to 235 years There will be some selected large trees retained under this strategy to meet the need for large woody debris in streams in Alternatives B-Modified, F and I Alternative C-Modified will provide for the highest number of large trees being left, as no timber harvest is scheduled in riparian zones

In Alternative C-Modified, riparian areas are managed as indicated above. In addition, approximately 414,907 acres in Alternative C-Modified is managed at moderate intensity to produce large-diameter ponderosa pine trees This management scheme uses a rotation age of 130 to 150 years, usually including one commercial thinning for even-aged management strategies Approximately 309,060 acres in Alternative C-Modified consists of sites which are suitable for growing ponderosa pine but which currently support mixed conifer species This regime will result in a shift to ponderosa pine and other shade-intolerant species on most of these acres This change will begin immediately, but the largest shift will occur during the third through eighth decades when most of the currently mixed conifer sites are regenerated to ponderosa pine Alternative C-Modified not only shifts species composition to ponderosa pine but also perpetuates it. This could be done manually, with herbicides, or with low-intensity prescribed fires. The age-class distribution on these acres will tend toward the later seral stages This trend will become most evident in the sixth or seventh decade

Another medium level of intensity can be found in Alternative I In Alternative I, many of the 479,148 acres currently supporting mixed conifer species would be managed to produce ponderosa pine to a rotation age of approximately 100 years for even-aged stands. Uneven-aged management will also be used in Alternative I to achieve the ponderosa pine conversion goal, with approximately 15,000 acres of the 148,319 mixed conifer acres being converted This will result in a shift to ponderosa pine and other shade-tolerant species on 454,388 acres in Alternative I The age-class distribution on these acres will be the same as the lands managed under high intensity for even-aged systems and towards the later seral stages in those stands using uneven-aged systems.

Old-growth replacement stands (mixed conifer only) produce a medium level of intensity in Alternative I This management intensity uses an extended rotation of 140 to 160 years to produce trees 24 inches in DBH at final harvest This scenario will produce an age-class distribution towards the later seral stages. Ponderosa pine volume will be at that level naturally found in those stands, i e , 90 percent for pine climax sites and about 50 percent for mixed conifer sites Actual harvest diameters will be around 20+ inches at final harvest, if replacement of dedicated old-growth stands is found not to be necessary.

The acres of land managed for a low intensity of timber production in each alternative occur in visually sensitive foreground areas. These areas receive a modified form of uneven-aged management in which the trees will grow to large sizes (26-36 inches) before harvesting High-intensity management harvests trees at about 18 inches diameter at breast height. Following each harvest, there will be more trees remaining in the stand than there would be under high-intensity management. In addition, three to five large trees per acre would always be retained This type of management results in a slow growing, natural-appearing stand of trees at all times (General effects of this type of management are discussed in Chapter III Further discussion about the selection of harvest cutting methods can be found in Appendix E). The acres treated with various intensities of timber management are displayed in Figure IV-3

FIGURE IV-3: Acres Treated by Timber Management Intensity by Alternative

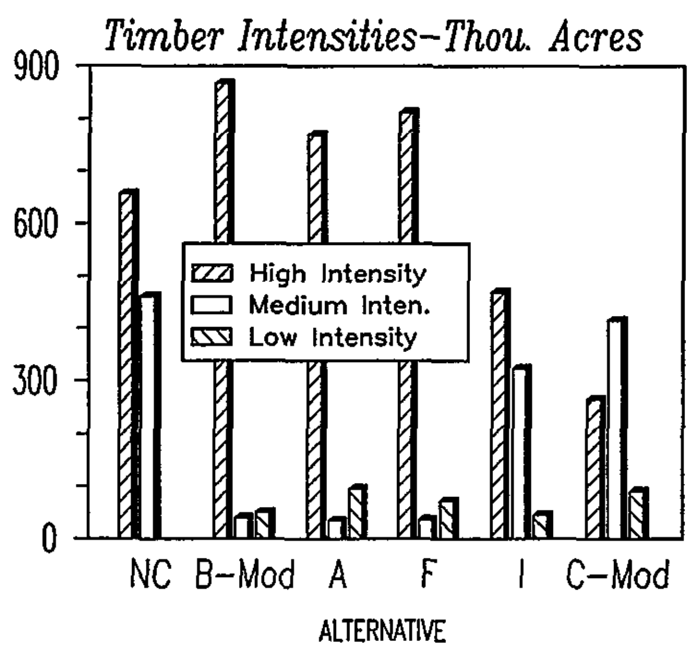


Table IV-2: Summary of Timber Management Intensities by Alternative

	Alternatives					
	NC (No Change)	A (No Action)	B-Mod	C-Mod	F	I
High	655,770	769,160	866,977	265,232	811,952	468,656
Medium	460,807	34,384	39,691	414,907	36,115	322,862
Low	0	94,880	50,115	90,248	71,681	44,452
Total	1,116,577	898,424	956,783	770,387	919,748	835,970

Changes in the types of trees present will cause changes in the insect and disease activity on the Forest (See discussion of current situation in Chapter III) In Alternatives NC, A, B-Modified, and F, there will be an increase in predominantly fir stands to well over 500,000 acres by the end of the third decade Fir species are more susceptible to disease than pine species, the susceptibility to disease increases with increased management activity because of activity-caused damage While increased losses to disease are probable, the increased growth from faster wood fiber producers may offset those losses (Dezellem 1985)

In addition, fir stands provide habitat for the western spruce budworm and the tussock moth It can be expected that there will be periodic outbreaks of both these insects due to the amount of habitat provided in each of the alternatives listed above; however, the risk of outbreaks is anticipated to decrease over the next 30 years as host stands respond to intensive timber management (Brookes et al , 1985, Brookes et al , 1978) Even though some growth loss will occur from outbreaks, the trees will be vigorous and should survive in sufficient numbers to ensure continued management of these stands It can also be expected that effective Forest-wide or site-specific insect control spraying projects using environmentally acceptable insecticides may be needed to control the extent of outbreaks that do occur

Ponderosa pine is much less susceptible to diseases and, under specific levels of stocking control, is not highly susceptible to mountain or western pine beetles In Alternatives NC, A, B-Modified, F, and I, pine trees should remain healthy and vigorous In Alternative C-Modified 309,060 additional acres as noted are managed to produce ponderosa pine In Alternative C-Modified, this means a total of 481,783 acres will be managed to produce large, mature ponderosa pine. These trees should remain healthy during the early decades, however, insect activity will probably increase in these stands after they pass culmination of mean annual increment In Alternative I, a total of 454,388 acres will be managed to produce ponderosa pine at economic rotations, of about 100 years, with about 125,578 acres managed with uneven-aged methods to produce ponderosa pine In Alternatives C-Modified and I, the remaining fir stands will be susceptible to the same risks as noted above

In all alternatives except Alternatives NC and A, there will be a risk of increased insect and disease activity in riparian and visually sensitive areas because of the species changes in these areas from pine to fir, and/or trees in these areas will be retained past culmination of mean annual increment Those trees carried many decades past culmination of mean annual increment will be growing less vigorously and may become more susceptible to attack from various pests

There will be an increase in the activity of pocket gophers directly related to the number of acres regenerated in each alternative These animals have the potential to kill or severely damage trees on about 25 percent of the acres receiving regeneration management activity in the ponderosa pine and Douglas-fir tree species. Control activity will consist of silvicultural methods (i e , size of units and/or type of cuts) and poisons. Alternatives that have large acreages receiving regeneration harvest activity will also have large numbers of acres treated for pocket gophers Alternatives will have between 1,000 and 3,000 acres treated with poison annually for pocket gopher control.

b *Timber Management Effects on Old-Growth Trees*

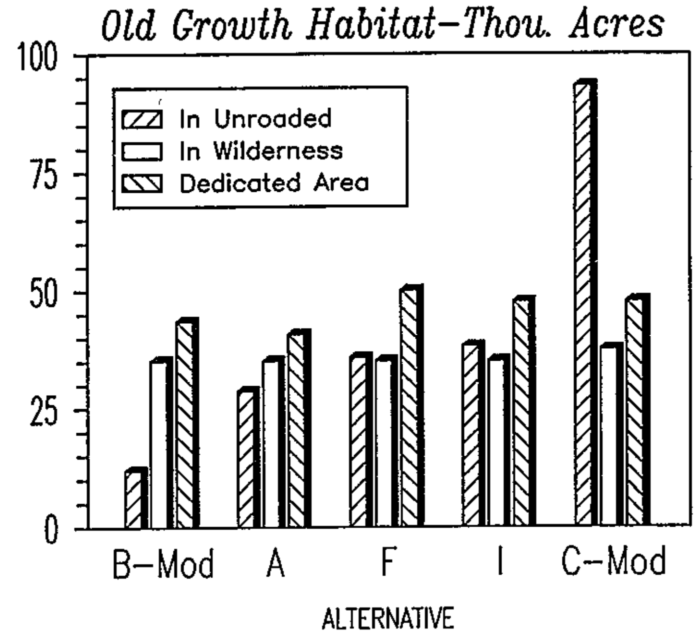
Each of the alternatives retains some timber stands in old-growth status, seral stages 5-6. (See Chapter III for definition of old-growth stands) The main variation between alternatives is the amount of forest lands retained in this status

Old-growth assignments were distributed throughout the Forest. See Appendix G (dedicated stand alternative) and response to comments on old-growth management for descriptions of the process

In addition to the acres identified as dedicated old growth, additional acres of old growth which meet snag and down material requirements (defined by the Pacific Northwest Regional Guide) occur in wilderness, undeveloped areas, and the bald eagle winter roosts. In these areas, vegetation will progress through its natural successional stages barring any natural catastrophe such as insect infestation, disease, fire, or windstorm. Management of these areas precludes any timber harvest which would alter the old-growth characteristics. Old growth not only provides wildlife habitat, but also ecosystem diversity, and may provide spiritual or aesthetic values to humans In Alternative I, an additional 25,000 acres will be managed on extended rotation to produce old growth replacement stands. Timber management will be the same as in normal even-aged or uneven-aged prescriptions for the first 100 years, with little activity occurring for the next 40 to 60 years in order to produce a stand which will have about 50 percent of the trees 25 inches or greater. The main variation between alternatives is the number of acres assigned to management areas which do not allow for timber management activities

The total number of acres which will provide old growth through all decades by alternative is displayed in Figure IV-4.

FIGURE IV-4: Acres of Old Growth by Alternative 1/



1/Alternative NC manages 123,587 potential old-growth acres on the Forest on a 260-year rotation using the three-tier system, maintaining old growth at 5 percent in timber and range emphasis areas and 10 percent in wildlife emphasis areas Old growth data for the unroaded category includes 3,350 acres within bald eagle winter roosts

In addition to the acres displayed in Figure IV-4, visually sensitive areas, old-growth replacement stands, and wildlife emphasis areas, as well as managed forest lands will provide some characteristics of old growth

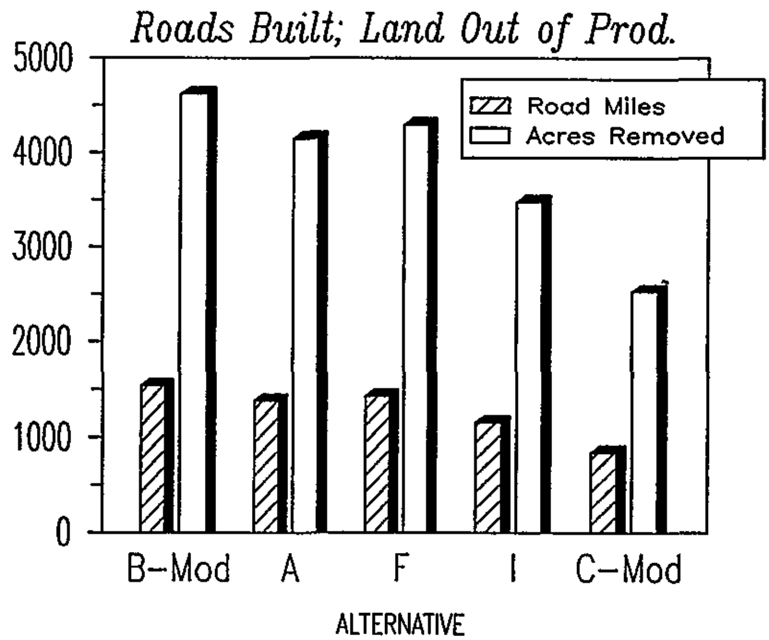
The visual zones, wildlife emphasis, and general forest, however, will be managed to produce values other than old growth Over time, the number of snags, down material, and the multistoried stands required for old growth may not be present in these areas. Old-growth replacement stands will be managed to meet old-growth characteristics, but not all stands will meet them at different times during the rotation.

There will be a risk of increased insect activity in old-growth stands They could become infestation centers to produce epidemic populations of insects which would then move into the rest of the Forest This risk increases with increased acres of old growth and it increases over time, but it is somewhat mitigated by the many insectivorous birds which are anticipated to be at optimum levels in old-growth stands

c *Effects of Roads on Trees*

To provide access for management activities in each alternative, additional roads will be constructed The general effect of the transportation system on trees is to eliminate land from production of trees. The main difference between the alternatives is the miles of road built and the number of acres removed from production of trees Figure IV-5 displays the miles of road built over 50 years and the acres removed from tree production, by alternative

FIGURE IV-5: Miles of Road Built and Acres Removed from Tree Production



d. *Effects of Mining on Trees*

Operations taking place under the authority of the Mining Laws have the right to remove trees which are within the area proposed for mining Trees needed for mining purposes may be obtained free of charge from the operator's mining claims Merchantable timber, which is not needed for mining purposes, remains government property and is sold separately. These impacts are removed from any planned sale activity by the Forest, and must be dealt with as they arise

e *Effects on Cumulative Timber Supply*

Lumber mills within and adjacent to the Malheur National Forest's zone of Cumulative influence are expected to experience a reasonably stable timber supply from the Timber Supply Forest over the next 15 years However, the supply of high-quality, large diameter sawlogs will diminish over time, and may not satisfy demand Projections indicate that the supply of non-National Forest stumpage will remain near present levels, although the contribution to total supply is not substantial (around 10 percent of total). Consequently, because of the dominant supply position of National Forests in the local area, harvest levels proposed under the different National Forest management alternatives are critical to the cumulative timber supply available Table IV-3 displays the total harvest volume expected in Grant and Harney counties for each decade by alternative.

TABLE IV-3: Total Projected Harvest by Alternative
Grant and Harney Counties
(Average Annual Harvest in Millions of Board Feet)2/

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
Non-National Forest Volume	42	22	34	34	30
Other National Forest Volume1/	70	70	83	83	83
Forest Supply by Alternative 3/					
Alternative NC (No Change)	N/A	N/A	387	N/A	N/A
Alternative A (No Action)	N/A	N/A	350	350	348
Alternative B-Mod	N/A	N/A	383	383	379
Alternative C-Mod	N/A	N/A	271	271	267
Alternative F	N/A	N/A	364	364	360
Alternative I (Preferred)	N/A	N/A	328	328	324
Estimated Demand by Period4/			300-348	309-365	318-383

1/Figures presented here include 40 MMBF from the Ochoco National Forest in Harney County and 43 MMBF from the Umatilla National Forest in Grant County These supply estimates from other National Forests represent projected harvest levels, from the preferred alternatives of the Forest Environmental Impact Statements and Forest Plans Estimates were obtained by prorating projected Forest harvests against acres of the respective Forest in Grant and Harney Counties

2/Assumes a constant cubic foot/board conversion ratio over all displayed time periods for individual alternatives Forest supply by alternative estimates include timber sale program quantity from the Malheur National Forest (specific to alternatives) plus non-National Forest and other National Forest volume

3/The No Change Alternative is based on the 1979 Timber Resource Management Plan (TRP) The first decade projected harvest for this alternative is assumed to be the potential yield of 269 7 MMBF, although actual programmed sell levels are lower The 1979 TRP does not project harvests in later decades, thus, no projection are made for later decades

4/From Table III-6

Cumulative Supply 1990-1999 As displayed in Table IV-2 above, all alternatives except C-Modified contributes enough to the total supply picture to satisfy the lower bound demand estimate for the 1990-99 period. The total supply associated with Alternative I is near the midpoint of the range of estimated demand, and the probability of supply satisfying local demand is estimated to be greater than 50 percent. All other alternatives would supply stumpage apparently in excess of estimated demand. In actuality, any excess supply may encourage growth in existing industry in the zone of influence or growth in adjacent areas which may expand the Forest zone of influence. Also, increased competition may occur for the supply of timber from the Forest as a result of reductions in timber supplies in surrounding areas

Cumulative Supply 2000-2009. Under the assumption that demand will increase 3 to 5 percent over the 1990-1999 period, all except Alternative C-Modified contributes enough to the total supply picture to satisfy the lower bound demand estimate However, Alternative I is somewhat near the lower bound of demand, which may result in demand exceeding supply. Alternatives A, B-Modified, and F project supply levels near the upper bound of demand, and excess supply may be available However, growth in the timber industry within or adjacent to the Forest zones of influence may occur, absorbing any excess supply Projections of supply for Alternative NC are not available

Cumulative Supply 2010-2019 With the assumption of a steady 3 to 5 percent growth in demand during the 2010-2019 period, Alternative C-Modified continues to result in insufficient supply for estimated demand Under Alternative I, the growth in demand would probably be minimally met by the total supply All other alternatives would also result in cumulative supply levels within the range of estimated demand for the period. No significant oversupply is projected, and most alternatives are near the midpoint of the estimated demand range Projections of supply for Alternative NC are not available

Discussion of Results The interaction of the cumulative supply, by alternative, with the projected demand by time period is contingent on several important assumptions Perhaps foremost are the assumptions underlying the estimates of demand For example, if no growth in demand were to occur and demand remained at the 1980-85 level, all alternatives (except Alternative C-Modified) would result in an adequate (or greater) cumulative timber supply Correspondingly, if major long-term increases in demand were to occur (if, for example, adjacent supply sources reduced their offerings), the cumulative supply under most alternatives would not meet the demand For all alternatives, the cumulative supply over time is relatively stable, reflecting the high percentage of publicly managed raw material in the total supply picture Based on past management practices and policies, the publicly-managed stumpage will generally be available regardless of market forces.

In general, the cumulative supply picture within the Forest's zone of influence is highly dependent upon the supply actions (i e., the harvest levels) of the National Forests within the zone. However, because of the large public holdings, fluctuations in local timber supply are expected to be minimal because of agency policies (e g., nondeclining flow) Opportunities to increase supply quickly, in response to market forces (e g , rising prices for stumpage) will be foregone Strong increases in demand without similar increases in supply would result in price increases and possible market reactions similar to the late 1970's and early 1980's. The market conditions during this period were marked by speculation on continued inflationary trends, and eventually resulted in the timber buy-back program

Projections of some combined effects of current demand and anticipated future supply conditions are as follows

1 In general, the supply of National Forest timber for Grant and Harney counties will be sufficient for existing local industries Industry employment will be relatively stable

2. Some increases in demand for Malheur National Forest timber may occur as adjacent Forests analyze their timber holdings and revise harvest levels. Demand for the high-quality, large-diameter ponderosa pine on the Malheur National Forest will intensify as the supply of that type of material diminishes in surrounding market areas (e g , Baker, Bend, Boise) This is presently being realized in the local area

3 Local industries may expand or new industries may locate in the Forest zone of influence if supply from the Forest increases substantially This movement of industry will be in response to perceptions of ample supply from National Forests in Grant and Harney counties Implicit in any industrial expansion or relocation in the Forest zone of influence is the expectation that investments will be recovered over a substantial period of time, essentially through sustained supply

4. Other sources of supply (i e , private or other public ownerships) will continue to provide some raw material, but in relatively small amounts. Private ownerships will supply

stumpage after consideration of price trends or, in the case of industrial ownerships, as supply needs dictate The National Forests and other public ownerships will schedule harvests regardless of pricing factors

f. Mitigation Measures

Mitigation measures such as designated skid trails, directional falling, equipment size limitations, line pulling, and stage logging will be used to protect or lessen the physical damage or loss of trees which are to remain on a site following timber harvest These measures, individually or in conjunction with each other, should help achieve successful mitigating results for 75-80 percent of the time (Kile 1981, Perry 1984)

These same measures will be used to reduce the loss to disease agents, mainly by preventing damage to the trees or excessive activity on the site which would increase the trees' susceptibility to damage Again, success should occur 75-80 percent of the time

Silvicultural practices will also be used to mitigate losses due to insects and disease. These practices include species selection for a site, stocking level control, and number of entries allowed in a stand These methods will vary in their success at controlling losses A species change may solve a root rot problem entirely, while stocking level control may only lessen the impact of the western spruce budworm (Dolph 1985; Hadfield 1984; Hadfield 1985; McArthur 1985, Twardus et al., 1984)

Following mining activity, reclamation will include such measures as may be necessary to re-establish trees in the impacted areas Measures used are natural regeneration, and planting of young trees in large cleared areas which will not readily revegetate through natural processes

g Relationship with Plans of Others

A summary of the response of alternatives to the basic objectives of the Forestry Program for Oregon can be found in Table IV-4 Four alternatives (Alternatives A, B-Modified, and F) meet the timber output levels desired by this program Two alternatives (Alternatives C-Modified and I) do not meet those output levels in any decade. Alternative NC meets the program in the first decade Due to lack of specific information after the first decade, no volume projections can be made

The State Board of Forestry's Forestry Program for Oregon target levels related to timber production must not be confused with the State of Oregon objectives reflected in the Governor's response nor the State Alternative prepared for the forest plan Objectives guiding the Governor's response include concerns for Oregon's forest environment, wildlife protection, jobs, and timber production An equitable balance among these often conflicting resources is the principal goal

TABLE IV-4: Relationship of the Proposed Action and Alternatives to the Basic Objectives of the Forestry Program for Oregon Proposed Action and Alternatives

	Basic Objective	Level 1 1/	Level 2 2/	Level 3 3/
1a	To maintain the maximum potential commercial Forest land base consistent with other resource uses while assuring environmental quality	A,B-Mod,F, NC	C-Mod,I	
1b	Oregon Department of Forestry Compatibility Standard Alternatives are compatible with objective if the acres suitable for timber management meet or exceed the suitable land base used in the maximum Present Net Value benchmark run, constrained by Management Requirements	B-Mod	F,NC	A,C-Mod,I
2a	To identify and implement economically feasible levels of intensive Forest management required to achieve cost-effective growth and harvest	A,B-Mod,F, I,NC	C-Mod	
2b	Oregon Department of Fish and Wildlife Compatibility Standard An alternative is compatible with the objective if alternative equals 90 percent or more of the number of acres allocated to the full timber yield in the maximum Present Net Value benchmark, constrained by Management Requirements	B-Mod	A,F	C-Mod,NC I
3a	To maintain community stability by remaining flexible for increases in future harvest levels that would offset projected shortages	A,B-Mod F,NC	I	C-Mod
3b	Oregon Department of Fish and Wildlife Compatibility Standard An alternative is compatible with this objective if the number of jobs and income levels and payments to counties meets or exceeds the current direction levels of these parameters during the first decade	B-Mod F,NC	A,I	C-Mod

1/Meets share of Forestry Program for Oregon target level and is compatible with basic objective
2/Compatible with the basic objective but does not meet target level or meets the target level but is not compatible with the basic objective
3/Does not meet target level and is not compatible with the basic objective

Discussion

1a Congressional Acts and Executive Orders (Final Environmental Impact Statement, Chapter I) and State law (Oregon Forest Practices Act) mandate management guidelines for certain lands Incorporated throughout the planning process, these guidelines have served to define the suitable land for timber production that is compatible with the objective.

1b. Oregon Department of Forestry has stated the Forestry Program for Oregon acknowledges the need for minimum levels of environmental protection. While the Department believes that some Management Requirements may unnecessarily restrict timber management, they suggest use of the maximum Present Net Value with Management Requirements benchmark as the best available land base standard for comparison.

2a A full range of intensive timber Management Practices (refer to Management Strategies and Management Area Direction in Chapter II) is utilized for timber production New and improved practices would be implemented consistent with technological advances

2b The Oregon Department of Forestry defines the full timber yield as the maximum economic yield, constrained by a 95 percent culmination of mean annual increment Again, using the Management Requirement constrained acres as a standard does not mean the Department approves of all Management Requirement strategies The maximum Present Net Value benchmark identifies the economically feasible levels of Forest management for this analysis

3a Deviation from sustained yield management would be implemented consistent with National Forest Management Act regulations and Forest Plan direction This involves the harvest of available surplus old-growth inventory to offset projected shortages

3b The Forestry Program addresses timber harvest scheduling and the resulting effects on local communities and the economy of the State For most National Forests located in Oregon, the Oregon Department of Forestry has stated that departure from nondeclining flow will be necessary to maintain overall economic stability as private industrial harvests inevitably decline The three parameters listed will be measured to determine how each alternative maintains, improves, or decreases economic stability The Department believes that, although the current direction alternative on some Forests does not accurately represent the existing situation, it provides the best available basis for this comparison

In addition, a comparison of how the acres managed for timber production in the preferred alternative compare to the current Timber Resource Plan can be found in Table IV-5 This comparison shows that fewer acres are managed for timber production in Alternative I (preferred), and less acres are managed at higher intensities than under the Timber Resource Plan These changes result in a reduction of harvestable volume available in the first decade from the current plans, and lower harvest volumes than are actually being sold today This also does not meet or exceed the volume called for in the Forestry Program for Oregon

Alternative C-Modified harvests fewer acres and uses less-intensive timber management to produce lower volumes than are currently being sold (see Table II-6 for the average cut and sell volumes for the period 1980-1989), and thus does not meet the goals for the Forestry Program for Oregon

The other alternatives (Alternatives A, B-Modified and F) exhibit this same trend. Alternative NC exceeds the volume called for in the Forestry Program for Oregon in the first decade Due to lack of specific information regarding management activities in the NC alternative, no volume projections are available for later decades

Alternatives A, B-Modified, and F will provide timber sell levels equal to or greater than historic levels (228 MMBF average annual from 1980-1989). Assuming that the local communities have been experiencing minor growth historically and are capable of dealing with community growth easily, community stability will be maintained in those alternatives which maintain a timber sell level equal to or greater than historic levels None of the alternatives would result in growth so rapid that it would cause destabilization of the community services Alternative C-Modified and, to a lesser degree I, (with timber sell levels slightly below recent historical levels) would result in reductions in employment opportunities and, consequently, some displacement in the local communities.

TABLE IV-5: Comparison of Preferred Alternative to Current Timber Management Plan

Timber Management Plan 1/	Alternative I (Preferred)	Reason for Change
A Land Suitability	These changes in suitable land acreage are consistent for all alternatives in this final EIS	These changes are due to
1 Lands available for timber harvest number of acres in Standard, Special, and Marginal, and upon which a regulated harvest was based 1,123,123		The correction of forested acres with a new mapping system, identification of sites with regeneration difficulties, reduction for transportation system,
2 Acres of RARE II roadless areas which were suitable for timber harvest and upon which timber harvest was deferred pending resolution of the wilderness issue 25,948	Total change = 83,255 acres	The 1984 Oregon Wilderness Bill added to Strawberry Mt Wilderness and created the Monument Rock Wilderness, 1988 Wild and Scenic Rivers Act reduced suitable acres
	Tentatively suitable lands - Lands which scheduled timber harvest is permitted 1,039,868	Suitable acres vary by alternative design The following is specific to Alternative I (preferred)
2a Unregulated Acres Roadless management areas found in the established unit plans	47,690	Acreage dedicated for old-growth management
33,361	60,228	Acreage in Semi-Primitive, Scenic, Wildlife Emphasis
	2,231	Bald Eagle Winter Roosts and Special Interest Areas
	24,568	Riparian zone acres removed from scheduled harvest
	40,091	*Acreage identified with* spatial infeasibilities
	29,090	Acres economically poor for timber production
3 Total acres of commercial forestland	Total suitable acres	
1,182,432	835,970	Total Change -346,462

1/Information available during development of the Forestry Program for Oregon (1982)

1979 Timber Management Plan1/	Alternative I (Preferred)	Reason for Change
B Timber Management Intensities		
Number of acres selected and managed for	Number of acres selected and managed for	Alternative I is less of a commodity-oriented alternative The result is that fewer timbered acres
1 Full Yield (91-100%) 657,750 2/	1 Full Yield (91-100%) 468,656 3/	are scheduled to receive full-yield timber harvest prescriptions than in the current Timber Management Plan
2 Partial Yield (50-90%) 465,373 4/	2 Partial Yield (50-90%) 322,862 4/	Riparian areas are not the only areas to receive this moderate level of management in this alternative Acres managed for subclimax ponderosa pine on climax mixed conifer sites receive a moderate level of management Old growth, wildlife, streamside management units, visual resource management areas, lodgepole pine type, and other special areas received this level of management in the current Timber Management Plan
3 Partial Yield (1-49%) 0 4/	3 Partial Yield (1-49%) 44,452 4/	Foreground visual management areas receive this level of timber management in the preferred alternative No acres received this level of timber management in the Timber Management Plan

C Other Factors

Forestry Program For Oregon is based on a 55-year minimum age of harvest Culmination of mean annual increment constraint (or 95 percent thereof if based on 70 to 80 years) for all species in this alternative Forestry Program For Oregon assumes merchantability to a 4-inch top for all species, Alternative I assumes a 4-inch top for all currently managed stands in the first decade and a 4-inch top for all species, after the first decade, once stands are brought under timber management regimes.

2/ Generally equates to "standard" areas in timber plans

3/ Generally equates to Management Area #1 acreage in Forest Plan

4/ Land classifications/prescriptions which reduce timber yields from "full yield".